Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

A280.39
M34Am
Cop. 2

AMS-537

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY
JUN 10 1964
CURRENT SERIAL RECORDS

QUALITY AND RESPIRATION RATES IN STOCK FLOWERS TREATED WITH N^6 BENZYLAMINOPURINE

UNITED STATES DEPARTMENT OF AGRICULTURE • AGRICULTURAL MARKETING SERVICE
MARKET QUALITY RESEARCH DIVISION

PREFACE

Cut flowers are frequently exposed to unfavorably high temperatures in transit and during marketing, (as shown in the Department of Agriculture's "Transit Times and Temperatures of Transcontinental Cut-Flower Shipments," Marketing Research Report 592, and "Transit Temperatures of Cut Flowers Shipped From California," AMS–459). A possible means of reducing quality losses under such conditions, would be the use of a senescence inhibitor, such as N^6 benzylaminopurine. Stocks appeared to lend themselves to this type of study. This study is a part of a broad program of continuing research by the Agricultural Marketing Service to reduce losses in the quality of products in marketing channels.

The cooperation and assistance of the California Floral Traffic Conference, San Francisco, Calif., and the Santa Barbara Flower Growers, Los Angeles, Calif., is gratefully acknowledged.

WARNING

The test results given in the report are not intended as a recommedation for practical application of N^6 benzylaminopurine at this time, because this growth regulator has not been registered with the U. S. Department of Agriculture for use with flowers, as required by law for agricultural chemicals marketed in interstate commerce. No toxicity evaluations have been made for N^6 benzylaminopurine used in these tests.

Washington, D. C. June 1964

QUALITY AND RESPIRATION RATES IN STOCK FLOWERS TREATED WITH N^6 BENZYLAMINOPURINE

By M. Uota and C. M. Harris[1]
Market Quality Research Division, Agricultural Marketing Service

CONCLUSIONS AND SUMMARY

The display life of stock flowers (*Matthiola incana* (L.) R. Br. var. Avalanche) was extended significantly when plants were treated with 25 or 50 p.p.m. N^6 benzylaminopurine. The most pronounced effect of the compound was on the foliage. After dry storage at 50° F. for 5 days, the leaves were slightly wilted but they regained turgidity rapidly when the stalks were immersed in water. The leaves in the treated lots remained dark green and turgid during subsequent holding for 3 days at 70°, while the leaves of the untreated plants yellowed rapidly and soon became unsalable.

Inflorescences of treated and untreated plants were about the same immediately after holding 5 days at 50° F., but after an additional 3 days at 70°, blooms treated with N^6 benzylaminopurine were much superior to untreated blooms.

Elongation and consequent stringiness of the inflorescence was much greater in flowers held in the dark than in those held in the light. N^6 benzylaminopurine inhibited elongation in plants held either in the dark or in the light.

The respiration rate was significantly decreased by N^6 benzylaminopurine at 50° F. and 68°.

Quality effects from applying N^6 benzylaminopurine to stock flowers appeared to be a combination of the retention of chlorophyll, a decrease in the rate of respiration, and a suppression of the elongation of the growing tip. Delays after harvest in the application of the material decreased its effectiveness.

BACKGROUND

The effect of kinins as senescence inhibitors in plant tissues has been reported by a number of workers (*1*, *2*, *4*, *6*, *8*, *12*, *13*).[2] Some have found that a decrease in the respiration rate is associated with the apparent delay in senescence (*1*, *2*, *4*). However, Lipton (*8*) and Krul and others (*7*) reported an increase in the respiration rate and a longer postharvest life. Smock and others (*10*) observed a slight increase in respiration rate, but only in apples that were in the preclimacteric stage.

Kinins are also known to affect the elongation of growing plant stems. Sommers (*11*) found that the lateral expansion of pea seedling sections was increased with kinetin, and Katsumi (*5*) reported inhibition of elongation accompanied by weight increase, in those treated with kinetin.

Because of the practical value of color retention and suppression of stem elongation in the marketing of freshly cut stock flowers, tests were conducted to determine the effect of N^6 benzylaminopurine on the elongation of the rachis and the retention of green color by the foliage and stems.

MATERIALS AND METHODS

Stock plants (*Matthiola incana* (L) R. Br. *var.* Avalanche) grown in Ventura County, California, were used in these experiments. Plants with one-quarter of the blooms open in the inflorescence were selected.

In most tests plants were sprayed with N^6 benzylaminopurine approximately 2 hours before pulling. The spray solution contained 25, 50, or 100 p.p.m. N^6 benzylaminopurine in water and was applied with a hand sprayer, covering all plant parts above the ground. In some experiments, the plants were treated 24 hours after harvest.

After the plants were pulled up, the roots were cut off at soil level and the stems were placed in water. These plants were transported to Fresno in a refrigerated container maintained at 45° to 50° F. The plants were held overnight in water at 50° and packed the next morning after being composited into replicated lots. The flowers were packed dry in regular fiberboard shipping containers for holding tests under simulated commercial conditions.

After 5 days at 50° F., the flowers were removed from storage, and the ends of the stalks

[1] Dr. Uota is senior horticulturist and Mr. Harris is assistant plant physiologist, U. S. Horticultural Crops Laboratory, 2021 South Peach Ave., Fresno, Calif.

[2] Italic numbers in parentheses refer to items in Literature Cited, page 8.

were recut, and placed in jars of fresh water. At this time the foliage and flowers were rated for quality on an arbitrary numerical scale ranging from 1 through 5; 1 indicated no remaining display life, 2 was unsalable, 3 was fair, 4 was good, and 5 was field fresh. In rating the condition of the blooms, judges considered the color and shape of the petals, the elongation of the tips of the inflorescence, and the color of the sepals. Foliage was evaluated primarily on the color and turgidity of the leaves. Additional ratings were made after 2 and 3 days at room temperature.

Elongation of the inflorescence was studied in 6.5-cm. sections taken from the tips of inflorescences with tight buds. A 40-mm. segment at the tip of each section was measured and marked with carbon ink. One lot was treated by dipping the entire section in a 25 p.p.m. N^6 benzylaminopurine solution for 5 minutes, after which it was drained and dried. This lot was held with the cut ends of the sections in distilled water. Another lot was treated by immersing the cut end of the section to about 5 mm. in a 25 p.p.m. solution for the duration of the experiment. A third lot was held with the tips immersed to a similar depth in distilled water. One-half of all the samples was held in complete darkness and the other half was illuminated with a 15-watt fluorescent lamp at a distance of about 10 inches. The samples were held for 4 to 5 days at 64° F. and at 100 percent relative humidity before the amount of elongation was measured.

Respiration rates of individual blooms of various maturities were measured with a Warburg constant-volume respirometer. Respiration rates of these blooms were based on O_2 uptake and expressed as QO_2 (microliters of O_2 per milligram of fresh or dry weight of tissue per hour). The buds used in this experiment were dipped in water (check) or in 25 p.p.m. of N^6 benzylaminopurine solution for 10 minutes and subsequently held at 68° F. The first respiration measurements were made 18 hours after the treatment.

Respiration rates of the whole flower stalks or intact inflorescences were made by forcing a stream of CO_2 free air through a glass vessel containing the plant material and subsequently through a nondispersive infrared analyzer. The carbon dioxide output was expressed as milliliters of CO_2 evolved per kilogram per hour.

The significance of the data obtained was evaluated by analysis of variance. When more than two means were compared, the Duncan (*3*) test was used. The means of the data in the figures 1, 2, 3, 6, 7, 8, and 9 not identified by the same letter are significantly different from each other at odds of 99:1.

RESULTS

Effects on Condition of Blooms

Both check (untreated) and treated flowers were in good condition after 5 days at 50° F. (fig. 1). However, during subsequent holding at room temperature, the blooms in the check lot deteriorated rapidly. After 3 days at room temperature the check lots were rated unsalable; the petals had become rather slim and pointed and were somewhat yellowed on the younger blooms, the sepals were faded, and the stems near the tips of the inflorescences were elongated and spindly. In the treated lot the petals were white, round, and fully shaped. The stems near the tips of the inflorescences were compact, green, and fresh in appearance. There was no difference between flowers treated with 25 or 50 p.p.m. N^6 benzylminopurine.

Effects on Appearance of Foliage

The effect of N^6 benzylaminopurine on the foliage was quite pronounced (fig. 2). After the 5 days at 50° F., the leaves of the check lot had started to turn yellow while those of the treated plants were dark green. The green coloration was maintained in the leaves of the treated plants during the 3 additional days at 70° F., while the leaves of the check plants turned yellow quite rapidly at this temperature. The foliage condition improved somewhat during holding at 70° due to the increased turgidity of the leaves, after the stalks were placed in water following the 50° holding period. Again, there was no difference between the effect of 25 or 50 p.p.m. active ingredient.

Effect on Elongation

N^6 benzylaminopurine suppressed the elongation of the flower tips (fig. 3), but this effect also was related to the absence or presence of light. Light suppressed elongation more than the N^6 benzylaminopurine. The effect of this chemical appeared to be independent of the effect of light, since the degree of inhibition was approximately the same in the light or in the dark. Under the conditions of this experiment there appeared to be some translocation of N^6 benzylaminopurine in the plant tissue

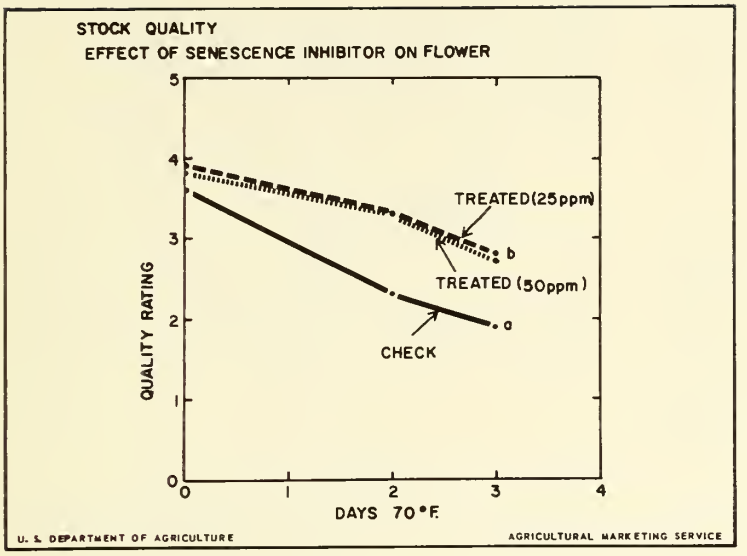


FIGURE 1.—Quality ratings of untreated stock blooms (check) and blooms treated with N^6 benzylaminopurine. Flowers stored at 50° F. for 5 days, then rated for quality after holding at 70° for indicated times.

AMS-703-64(4)

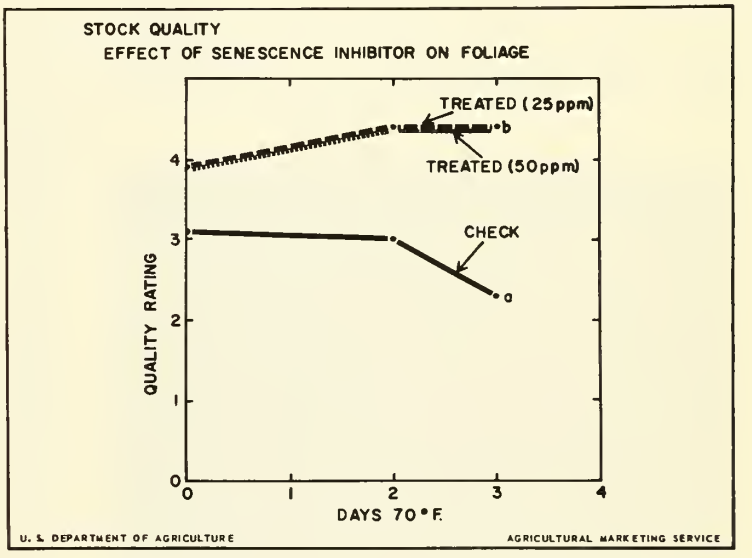


FIGURE 2.—Quality ratings of untreated stock foliage and foliage treated with N^6 benzylaminopurine. Plants stored at 50° F. for 5 days, then rated for quality after holding at 70° for indicated times.

AMS-704(4)

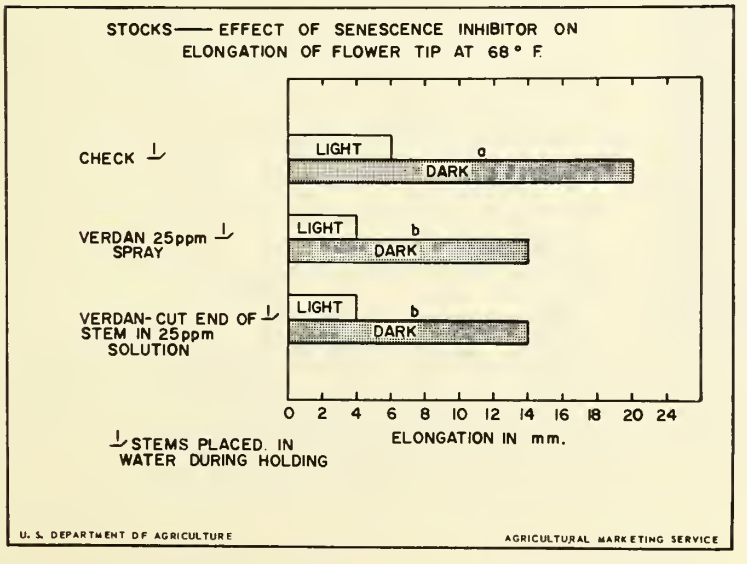


FIGURE 3.—Elongation of untreated tips of stock flowers and tips treated with N^6 benzylaminopurine (Verdan) during holding at 68° F. in darkness and in light. (Use of the trade name is for identification only and does not constitute endorsement by the U. S. Department of Agriculture.)

AMS-705-64(4)

since the degree of growth inhibition was approximately the same whether the plant was dipped before holding or only the tip was immersed in the solution during holding.

Effect on Respiration

Oxygen Uptake

Respiration rates were measured for buds of maturities 1, 2, 3, 4, and 5 (see fig. 4). The fresh weights of the buds were used to calculate the rates shown in figure 5.

Age of the treated and untreated buds was not the same at a given maturity since buds treated with N^6 benzylaminopuine required a longer time to develop (table 1).

The chemical, when applied as a dip, reduced the O_2 uptake at all maturities. The respiration rate was lower in stage 2 of maturity than in stage 1 and lower in stage 3 than in stage 2, but at later stages of maturity, when there was a rapid expansion of the floral parts, the rate of respiration increased. A similar relationship between growth and respiration rate was found by Siegelman and his coworkers (*9*) with rosebuds. When the QO_2 was calculated on dry-weight basis, the same relative differences in respiration rates were obtained at the various maturities.

BN-22079

FIGURE 4.—Stock buds of various stages of development used in respiration studies. Top to bottom: Maturities 1, 2, 3, 4, and 5.

TABLE *1.—Maturity ratings of stock buds untreated or dipped in N^6 benzylaminopurine solution for 10 minutes and held at 68° F.*

Treatment	Maturity Ratings		
	At time of treatment	3 days after treatment	6 days after treatment
Untreated (check)	1	2	3
	2	3	3.5
	3	3.5	4
	4	4	4.5
	5	—	—
N^6 benzylaminopurine (25 p.p.m.)	1	2	2.5
	2	2.5	3
	3	3	3.5
	4	4	4
	5	—	—

Carbon Dioxide Evolution

The carbon dioxide evolution from field-treated and untreated stock plants (the inflorescences and 10 leaves) held at 50° F. for 5 days are given in figure 6. The respiration rate decreased rapidly during the first 3 days, and then increased slightly after about 4 days. The pattern of CO_2 output was similar when only the inflorescences were used (fig. 7). The treated plants and the treated inflorescences respired at a significantly lower rate than the untreated ones.

In a test comparing flowers treated with 25 p.p.m. N^6 benzylaminopurine before harvest and those treated 24 hours after harvest, it was found that both applications decreased the rate of CO_2 output, but the rate was lowest in those treated in the field (fig 8). However, by the seventh day both lots were respiring at about the same rate. Delaying the application of the material until after harvest appeared to decrease its effectiveness.

At 50° F. the respiration rates of treated flowers were only slightly slower than the rates in untreated ones (fig. 9), but upon moving the blooms to a higher temperature (68°) after 5 days, the treated blooms respired at a significantly slower rate than the check lots.

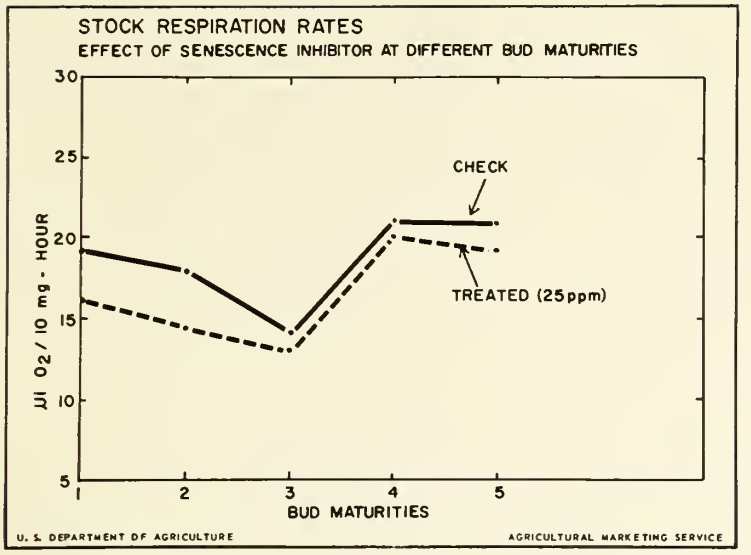


FIGURE 5.—Oxygen uptake of stock buds of various maturities at 68° F. Treated buds were dipped in 25 p.p.m. of N^6 benzylaminopurine solution.

AMS-706-64(4)

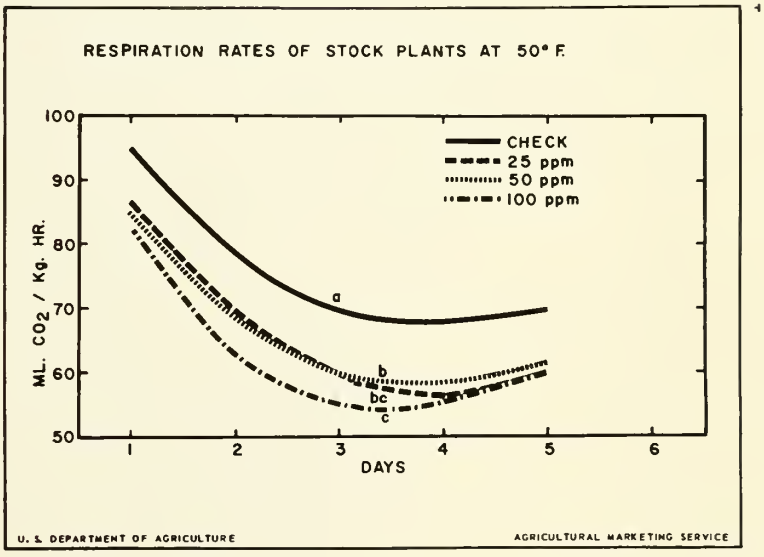


FIGURE 6.—Carbon dioxide evolution from untreated stock plants and plants treated with N^6 benzylaminopurine. Plants were held at 50° F.

AMS-708-64(4)

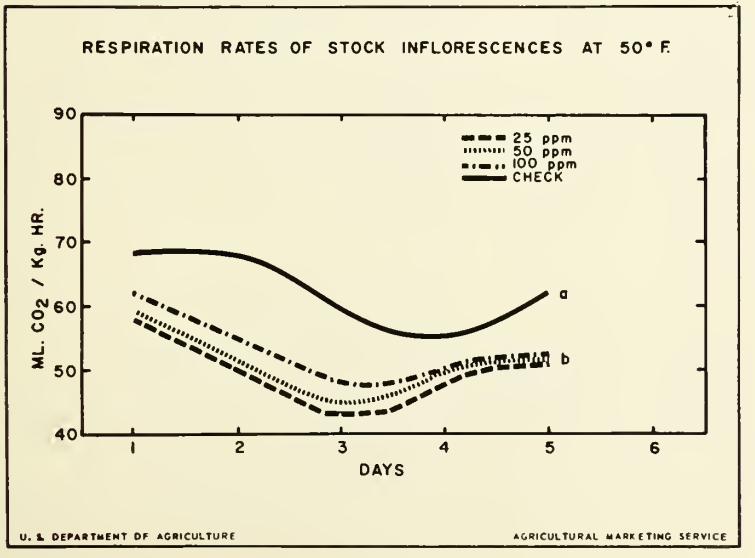
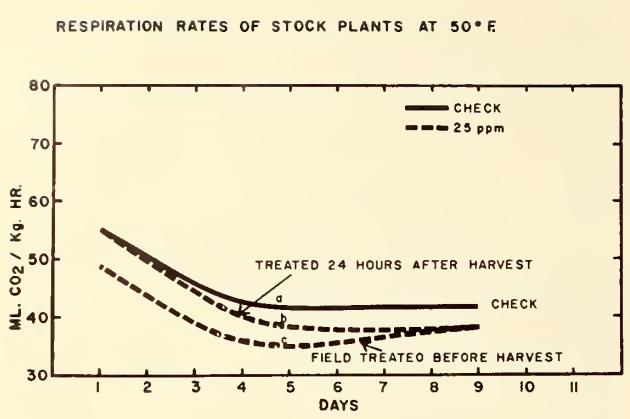


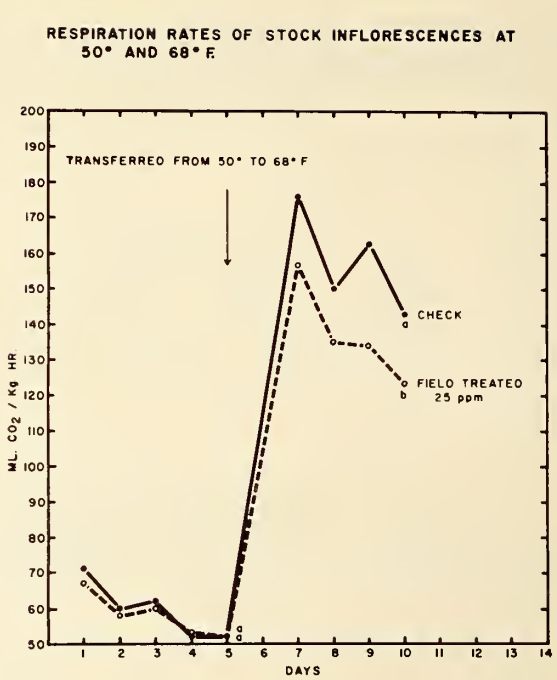
FIGURE 7.—Carbon dioxide evolution from untreated stock inflorescences and those treated with N^6 benzylaminopurine before harvest. Inflorescences were held at 50°. F.

AMS-709-64(4)



AMS-710-64(4)

FIGURE 8.—Carbon dioxide evolution from untreated stock plants and plants treated before or after harvest with N^6 benzylaminopurine. Plants were held at 50° F.



AMS-707-64(4)

FIGURE 9.—Carbon dioxide evolution from untreated stock inflorescences and those treated with N^6 benzylaminopurine. Inflorescences were held at 50° F. for 5 days, then transferred to 68°.

LITERATURE CITED

(1) Dedolph, R. R., Wittwer, S. H., and Tuli, V.
1961. Senescence inhibition and respiration. Sci. 134 (3485): 1075.

(2) Dedolph, R. R. Wittwer, S. H., Tuli, V., and Gilbart, D.
1962. Effect of N^6 benzylaminopurine on respiration and storage behavior of broccoli (Brassica oleracea var. italica). Plant Physiol. 37(4): 509-512.

(3) Duncan, D. B.
1955. Multiple-range and multiple-F tests. Biometrics 11: 1-42.

(4) Gilbart, D. A. and Parvin, P.E.
1962. Effects of N^6 benzylaminopurine and low temperature storage on the respiration rate and post-harvest life of the rose. Michigan State University. Abstracts of Papers Presented Before the American Society for Horticultural Science 59th Annual Meeting, Abstract 474: page 45, Aug. 25-29, 1962.

(5) Katsumi, M.
1962. Physiological effects of kinetin effect on the thickening of etiolated pea stem sections. Physiologia Plant. 15: 115-121.

(6) Kaufman, J., and Ringel, S. M.
1961. Tests of growth regulators to retard yellowing and abscission of cauliflower. Am. Soc. Hort. Sci. Proc. 78: 349-352.

(7) Krul, W. R., Griffiths, A. E. and Kingston, R. I.
1963. A study of factors modifying the effect of N^6 benzyladenine as a broccoli senescence inhibitor. University of Massachusetts. Abstracts of Papers Presented Before the American Society for Horticultural Science Sixtieth Annual Meeting, Abstract 458: page 68, Aug. 25-28, 1963.

(8) Lipton, W. J. and Ceponis, M. J.
1962. Retardation of senescence and stimulation of oxygen consumption in head lettuce treated with N^6 benzyladenine. Am. Soc. Hort. Sci. Proc. 81: 379-384.

(9) Siegelman, H. W., Chow, C. T., and Biale, J. B.
1958. Respiration of developing rose petals. Plant Physiol. 33(6): 403-409.

(10) Smock, R. M., Martin, D., and Padfield, C. A. S.
1962. Effect of N^6 benzyladenine on the respiration and keeping quality of apples. Am. Soc. Hort. Sci. Proc. 81: 51-56.

(11) Sommer, N. F.
1961. Longitudinal and lateral response of etiolated pea sections to indoleacetic acid, gibberellin, kinetin, sucrose, and cobaltous chloride. Physiologia Plant. 14: 741-749.

(12) Wittwer, S. H., Dedolph, R. R. Tuli, V. and Gilbart, D.
1962. Respiration and storage deterioration in celery (Apium graveolens L.) as affected by post-harvest treatments with N^6 benzylaminopurine. Am. Soc. Hort. Sci. Proc. 80: 408-416.

(13) Zink, F. W.
1961. N^6 benzyladenine, a senescence inhibitor for green vegetables. Agr. Food Chem. 9: 304-307.